Note. These were taken from "The Princeton Review AP Physics C Prep 2021".

1 Work

- Work is the dot product of force and displacement: $W = F \cdot x$
- When force varies with x, the work is given by the following equation: $W = \int F(x)dx$
- Work is positive when the force and displacement are parallel.
- Work is negative when the force and displacement are antiparallel.
- **Work-Energy Theorem**: $W = \Delta K = -\Delta U$

2 Energy

- Kinetic energy is energy associated with motion and is given by the equation $K = \frac{1}{2}mv^2$
- Potential energy is stored energy. The potential energy due to gravity is given by the equation $U_g = mgh$. The potential energy due to springs is given by the equation $U_s = \frac{1}{2}kx^2$
- Work done by a conservative force only depends on the initial and final positions, and not on the path taken. Gravity and springs are examples of conservative forces.
- Work done by a non-conservative force depends on the path taken, and mechanical energy is lost by heat, sound, and so on, when these forces act on a system. Friction and air resistance are examples of non-conservative forces.
- **Conservation of Mechanical Energy** states that the total mechanical energy of a system is constant when there are no non-conservative forces acting on the system. It is usually written as $E_\mathrm{i} = E_\mathrm{f}$ or $K_\mathrm{i} + U_\mathrm{i} = K_\mathrm{f} + U_\mathrm{f}$

3 Potential Energy Diagrams

- The potential energy can be given as $U(x)$. Then $F = -\frac{dU}{dx}$
- If $\frac{dU}{dx} = 0$, then $F = 0$, and it is an equilibrium point.
- Stable equilibrium occurs when the force restores the object back toward the equilibrium point after it is disturbed.
- Unstable equilibrium occurs when the force moves the object further away from the equilibrium point after it is disturbed.

4 Power

- Power is the rate at which work is done.

  $P = \dfrac{W}{t} = \dfrac{dW}{dt}$

  $P = Fv$